FAA-E-2606
October 2, 1974

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
SPECIFICATION

AIR TRAFFIC CONTROL RADAR BEACON SYSTEM (ATCRBS) VIDEO TEST SET

1. SCOPE

1.1 Scope.- This specification covers a portable video test set which will be used in conjunction with the existing FA-8169 test set for maintaining equipment at the transmitter site. Only the video test set will be required for maintaining equipment at the indicator site. The video test set will be mounted in its own cabinet and this cabinet will have the capability of sitting on top of the FA-8169 cabinet. The video test set will generate video test functions and the FA-8169 test set will basically generate RF test functions.

2. APPLICABLE DOCUMENTS

2.1 FAA Documents.- The following FAA specification and standards, of the issues specified in the invitation for bids or request for proposals, form a part of this specification.

2.1.1 FAA specifications.-

FAA-D-2494/1 and 2	Instruction Book manuscripts; technical equipment and systems requirements
FAA-E-163b	Rack, Cabinet and Open Frame Types
FAA-E-2319b	Air Traffic Control Beacon Interrogator
FAA-E-2352	Test Set, ATCRBS, I/R Site

FAA-G-2100/1	Electronic Equipment, General Requirements; Part 1, Basic Requirements for all Equipments
FAA-G-2100/3	Part 3, Requirements for Equipments Employing Semi-conductor Devices
FAA-G-2100/4	Part 4, Requirements for Equipments Employing Printed Wiring Techniques
FAA-G-2100/5	Part 5, Requirements for Equipments Employing Microelectronic Devices

2.1.2 FAA standards.-

FAA-STD-013a	Quality Control Program Requirements
Agency Order 1010.51A	U. S. National Standard for IFF MARK X (SIF) Air Traffic Control Radar Beacon System Characteristics

(Copies of this specification and other applicable FAA specifications, standards, and drawings may be obtained from the Contracting Officer in the Federal Aviation Administration office issuing the invitation for bids or request for proposals. Requests should fully identify material desired, i.e., specification, standard, amendment and drawing numbers, and dates. Requests should cite the invitation for bids, request for proposals, or the contract involved or other use to be made of the requested material.)

2.2 Military documents.- The following military specifications and standards of the issues in the invitation for bids or request for proposals, form a part of this specification:

MIL-C-3098	Crystal Units, Quartz, General Specification for
MIL-STD-461	Electromagnetic Interference Characteristics Requirements for Equipments
MIL-STD-470	Maintainability Program Requirements (For Systems and Equipments)
MIL-HDBK-472	Maintainability Prediction
MIL-STD-756A	Reliability Prediction Procedures
MIL-STD-781B	Reliability Tests; Exponential Distribution
MIL-STD-785	Requirements for Reliability Program (For Systems and Equipments)
MIL-T-21038	(SHIPS) Transformer, Pulse

AD 821 640* RADC-TR-67-108 Reliability Stress and Failure Rate Data for Electronic Equipment

(Single copies of Military specifications may be requested by mail or telephone from U. S. Naval Supply Depot, 5810 Tabor Avenue, Philadelphia, Penna. 19120 (for telephone requests, call 215/697-3321, 8 a.m. to 4:30 p.m., Monday through Friday). Not more than five items may be ordered on a single request; the Invitation for Bid or Contract Number should be cited where applicable.)

*Copies of this document can be obtained from the National Technical Information Service (NTIS), Operations Division, Springfield, Virginia 22151.

2.3 GSA document.- The following General Services Administration document, of the issue in effect on the date of the invitation for bids or request for proposals, forms a part of this specification, and is applicable to the extent specified hereinafter: GSA Stock Catalog, Part III, Hand Tools

(Copies of the GSA Stock Catalog, Part III, Hand Tools, may be obtained from Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., 20402; Price, 50 cents.)

3. REQUIREMENTS

3.1 Equipment to be furnished by the contractor.- Each video test set shall be in accordance with all specification requirements and shall include the major items specified in paragraph 3.1.1.

3.1.1 Equipment.- The video test set shall be housed in its own cabinet and have its own power supply. The major deliverable items required by the specification are the following:

(1) Video Test Set (3.4)
(2) Cables and Connectors (3.3.13)
(3) Special Tools (3.1.3)
(4) Instruction Books (3.1.2)

3.1.2 Instruction book.- The instruction book shall be a type A Equipment Instruction Book as referenced in FAA-D-2494/1; all applicable requirements of FAA-D-2494/1 and /2 shall apply.

3.1.3 Special tools.- All hand tools which are necessary for field maintenance of the equipment shall be itemized in the instruction book. Those tools which are not listed in the GSA Stock Catalog, Part III, Hand Tools, card extenders and extractors shall be supplied by the contractor with each equipment.

3.2 Definitions.-

3.2.1 Pulse measurements.- The following definitions apply when making pulse measurements: reference is made to Drawing A-31054A, attached. These definitions supersede pulse definitions in FAA-G-2100/1, paragraphs 1-3.2.14 through 1-3.2.17.

3.2.1.1 Pulse amplitude.- The pulse amplitude is defined as the amplitude "A" of the equivalent rectangular pulse.

3.2.1.2 Pulse duration.- The pulse duration is defined as the duration "t" of the equivalent rectangular pulse and is the duration of the actual pulse between the 50 percent amplitude points on the leading and trailing edges.

3.2.1.3 Pulse rise time.- The pulse rise time is defined as that portion of the total rise time for the pulse to change from 10 percent to 90 percent amplitude.

3.2.1.4 Pulse decay time.- The pulse decay time is defined as that portion of the total decay time required for the pulse to change from 90 percent to 10 percent amplitude.

3.2.1.5 Pulse slope.- The pulse slope is defined as the difference between the amplitude of the pulse when its leading edge passes from a substantially linear slope to a substantially non-linear slope and its amplitude at the instant when the trailing edge of the pulse pases from a substantially non-linear slope to a substantially linear slope. Slope shall be expressed in terms of percent of pulse amplitude.

3.2.1.6 Pulse train droop.- Pulse train droop is defined as the ratio of the difference between the amplitude of the first and last pulse in a pulse train to the amplitude of first pulse in that train.

3.2.1.7 Pulse spacing.- Measurements of spacing between pulses and other time measurements made with a pulse as reference shall be made with reference to the instant the leading edge of each pulse reaches 50 percent (point "h", drawing A31054A, attached) of the pulse amplitude.

3.2.1.8 Framing pulses.- Framing pulses are two pulses spaced 20.3 microseconds apart and used as the most elementary code.

3.2.2 Interrogation modes.- The interrogation modes referred to herein are comprised of two pulses designated P_1 and P_3. The time P_3 is considered zero range time. The spacing of pulses (3.2.1.7) for each interrogation mode is as follows:

Mode	Spacing (microseconds)
1	3 ± 0.1
2	5 ± 0.1
3/A	8 ± 0.1
B	17 ± 0.1
C	21 ± 0.1
D	25 ± 0.1

3.2.3 Side lobe suppression pulse.- The Side Lobe Suppression (SLS) control pulse is designated P_2. The pulse occurs 2.0 ± 0.1 microseconds after the first interrogation pulse P_1, as specified in the U. S. National Standard.

3.2.4 Reply codes.- The reply codes contain two framing or bracket pulses, from zero to a maximum of 13 information pulses, and a special position identification (SPI) pulse spaced 4.35 ± 0.1 usec after the last framing pulse. The reply pulse train in response to a particular interrogation mode shall be synchronous with interrogations on that mode. The reply code characteristics are described in the U. S. National Standard for the MARK X (SIF) Air Traffic Control Radar Beacon System Characteristics. Reply codes specified herein are in accordance with the U. S. National Standard.

3.2.4.1 Reply code identification.- Reply codes are classified as common system discrete reply codes and nondiscrete reply codes.

3.2.4.1.1 Common system discrete reply codes.- Common system discrete reply codes use the framing pulses plus the A, B, C, and D pulse positions and the SPI pulse. This provides 4096 reply codes and the capability of adding the SPI pulse to each reply code. The discrete reply code number consists of four digits. Each digit may have a value of 0 through 7. The first (most significant) digit consists of the sum of the subscripts of the "A" pulse positions employed, the second digit consists of the sum of the subscripts of the "B" pulse positions employed, the third digit consists of the sum of the subscripts of the "C" pulse positions employed, and the fourth digit consists of the sum of the subscripts of the "D" pulse positions employed. Identification may be accomplished by transmission of the SPI pulse, 4.35± 0.1 microseconds after the second framing pulse, or by the repetition of the entire code train with the first framing pulse of the second pulse train following 4.35± 0.1 microseconds after the second framing pulse of the first train. Assignment of reply codes not employing any of the "C" and "D" pulse positions to a "nondiscrete" code category leaves 64 discrete reply codes for air traffic control aircraft identification.

3.2.4.1.2 Common system nondiscrete reply codes.- Common system nondiscrete reply code structure is the same as the discrete reply code structure except that the "C" and "D" pulse positions are not employed. This provides 64 four-digit codes, with the last two digits always zero.

3.2.5 Fruit.- The term "fruit" as used herein is defined as pulses at the beacon receiver output which are not in synchronism with the interrogation period.

3.2.6 Defruit.- "Defruit" is a term referring to a technique of interference suppression wherein a beacon reply is checked for synchronism with the beacon interrogation rate to allow rejection of asynchronous beacon replies (fruit).

3.2.7 Three-pulse side lobe suppression (SLS).- Three-pulse SLS is a technique for suppression of transponder replies to interrogations by the side lobe radiation of the directional antenna. The interrogation mode pulse pair, P_1 and P_3, are radiated by a rotating directional antenna and control pulse, P_2, is radiated by an omni-directional antenna. The P_2 pulse occurs at a specific time interval after the first interrogation pulse, P_1, and at a fixed amplitude ratio with P_1. The airborne radar beacon transponder contains circuitry for amplitude comparison and pulse

spacing recognition of pulses P_1 and P_2 and for suppression of replies to side lobe interrogations.

3.2.7.1 Improved side lobe suppression (Improved SLS).- The operation of Improved SLS is basically the same as three-pulse SLS, except that P_1 is transmitted from both the directional and omni-directional antennas instead of only the directional antenna. This enables suppression of transponder replies to reflected-path interrogations by providing a direct-path P_1 signal for time and amplitude comparison with P_2.

3.2.8 Ripple voltage.- Ripple voltage is referred to as the peak-to-peak value of a simple or complex waveform consisting of power line frequency components and harmonics thereof, and synchronous and repetitive non-synchronous transients.

3.3 General requirements.- The basis of overall video test set design shall be the achievement of maximum operational reliability, availability and ease of servicing.

3.3.1 Solid state devices.- To ensure maximum reliability, the contractor shall design the circuitry of the video test set around semi-conductor devices in accordance with FAA-G-2100/3 and microelectronic devices in accordance with FAA-G-2100/5.

3.3.2 Printed wiring and printed circuit boards.- Printed wiring and printed circuit boards shall be as specified in FAA-G-2100/4.

3.3.3 Service conditions.- The service conditions shall be those specified in FAA-G-2100/1, paragraph 1-3.2.23. The AC line voltage shall be 120 volts and the ambient conditions shall be those of Environment II.

3.3.4 Power source.- The video test set shall operate from a single phase AC line power source. The design center value (1-3.2.21, FAA-G-2100/1) shall be 120V 60Hz.

3.3.5 Modular construction.- Plug-in solid-state modules shall be used to the maximum extent practicable.

3.3.6 Mounting.- The video test set shall be mounted in an instrument cabinet (3.3.7) and shall include facilities for mounting in a Type I Cabinet Rack (FAA-E-163b) when removed from the instrument cabinet as specified in 3.3.6.1.

3.3.6.1 Chassis mounting in cabinet rack.- The chassis shall be approximately 18 inches in depth and shall be designed in such a way that it and its complete slide assemblies can be easily removed from its individual instrument cabinet and easily installed by its slide assemblies into a cabinet rack. Front panel screws shall secure the test set into the cabinet.

3.3.7 Instrument cabinet.- An instrument cabinet shall be provided for the video test set. The overall depth of the combined cabinet and the video test set shall not exceed the overall depth of the FA-8169 Test Set (19 inches). The video test set cabinet shall be stackable on the FA-8169 cabinet with provisions (mechnical) made to prevent the video test set from sliding off of the FA-8169 test set no matter what angle the combination of the FA-8169 test set and video test set is adjusted to by the top shelf of the test set cart. In the stacked position the withdrawal of the video test set shall not mechanically interfere with the FA-8169 test set. When the video test set is withdrawn from its cabinet the combination of the video test set and FA-8169 test set shall not tip. The maximum height of the instrument cabinet with the test set mounted in the instrument cabinet shall not exceed 7 inches.

3.3.8 Front panels.- The front panel shall be in accordance with FAA-G-2100 (see supplement 4). Panel size shall be selectable from either size C or D in order to make the best space utilization of each front panel surface.

3.3.9 Chassis construction.- Chassis construction shall be such that all components parts, test points and internal maintenance adjustments shall be available from the front, or right, or left side of the chassis. The chassis shall be the horizontal drawer type and shall be mounted to the instrument cabinet by non-friction (roller type) slides. Complete withdrawal of the chassis from its cabinet shall be possible. Mechanical means shall be provided to lock the chassis in place in its full withdrawn position. It shall also be possible to easily remove the chassis from its slides and cabinet. When the video test set is extended on its slides, it shall be possible to tilt the test set at various angles for ease of maintenance.

3.3.9.1 Cable connectors.- All cable connections to the test set chassis shall be through cable connectors to facilitate quick removal from the instrument cabinet.

3.3.10 Grounding of equipment.- The video test set shall be grounded through the AC line cord (3.3.13) when the equipment is connected to a grounded, wall type convenience outlet or the grounded convenience outlet on the test set cart which was furnished with the FA-8169 test set.

3.3.11 Unit protection.- Each completely assembled unit of the video test set shall be so constructed that it can be removed from the instrument case and placed on a work bench for servicing, without damage to the units.

3.3.12 Panel protection.- Guard handles shall be provided on the front panel of the test set to protect the controls and indicators, as well as to aid in removing the test set from the instrument cabinet. The guard handles shall be of polished metal construction.

3.3.13 Video test set cables.- The following cables shall be provided:

a. Two AC line cord jumpers with three-wire grounding plug.

Hubbell type 5267 or equal, for connecting the equipment to the convenience outlet on the test cart furnished with the FA-8169 Test Set. (lengths - 4 feet and 10 feet).

b. Video cables type RG-59B/U with UG-260/U connector on each end. Two three-foot cables and two six-foot cables.

3.3.14 Connectors.- All coaxial connectors unless otherwise specified shall be the BNC type and shall employ the captivated contact principle. External jacks for the video signals shall be BNC type UG-262/U.

3.3.15 Power supplies.- All power supplies necessary for the operation of the video test set shall be provided in the video test set. A switch located on the front panel of the video test set shall turn the power on and off and a pilot light located on the front panel of the video test set shall indicate when power is being applied to the test set. All power supplies shall be electronically regulated.

3.3.15.1 Ripple voltage.- The peak-to-peak value of ripple voltages shall not exceed 0.1 percent of the d.c. power supply voltage for all electronically-regulated power supplies.

3.3.15.2 Power supply indicators.- Each circuit protected by a fuse or circuit breaker shall have an indicator lamp which shall be illuminated when the fuse or circuit breaker is open. Neon indicator lamps shall be used whenever possible. All indicator lights shall be uniformly located with respect to the associated fuses or circuit breakers, or they may be an integral part of the fuse holder assembly.

3.3.16 Reliability/maintainability.-

3.3.16.1 Reliability.- The video test set shall have a "Minimum Acceptable Mean-Time-Between-Failure (θ)" of 1000 hours, where θ is defined by MIL-STD-781B.

3.3.16.1.1 Reliability program.- A reliability program shall be performed in accordance with Section 5 (omit 5.2.4, 5.3.2 and 5.5.1) of MIL-STD-785A modified as follows:

(a) Existing available failure data or predicted failure rates for all types of parts in the equipment design shall be used to calculate equipment reliability. The contractor shall not perform statistical failure tests for the purpose of establishing parts failure rates and qualifying parts for use in the equipment.

(b) For those nonstandard parts for which failure rate is not available the procedure of paragraph 5.2.3 of MIL-STD-785A shall be followed.

3.3.16.1.2 Reliability prediction.- A design reliability prediction shall be made using the methods contained in paragraph 5.2, MIL-STD-756A and RADC-TR-G7-108, Reliability Stress and Failure Rate Data for Electronic

Equipment. Revised predictions are required when design changes or part substitutions affecting equipment reliability are made.

3.3.16.2 Maintainability.- All electronic and mechanical equipment and parts shall be designed and fabricated to minimize the skill, experience, and time necessary to assemble and maintain them. Corrective maintenance shall use a remove-and-replace philosophy with actual repair to the replacement module to be accomplished later in a separate maintenance area.

3.3.16.2.1 Maintainability program.- A maintainability program shall be performed in accordance with Section 5 of MIL-STD-470.

3.3.16.2.2 Maintainability prediction.- A maintainability prediction shall be performed in accordance with procedure two of MIL-HDBK-472. The mean-time-to-repair (MTTR) shall not be more than 30 minutes.

3.3.17 Radiation interference and susceptibility.- The design and construction of circuits, shielding, and filtering shall be such as to meet the radiated and conducted emanations and the susceptibility requirements of MIL-STD-461 for Class 1C equipment. The test performed shall be as listed in Table II of MIL-STD-461 for Class 1C equipment. The tests shall be conducted with the video test set removed from its instrument cabinet.

3.4 Video test set.- The video test set shall be designed to provide the following functional capabilities in accordance with the requirements of this specification:

(a) Synchronization, internal-external (3.4.1)
(b) Composite Video Outputs. (3.4.5)
(c) Interrogation mode trigger generator (3.4.2)
(d) Reply video code train generators (3.4.3)
(e) Noise generator (3.4.4)

3.4.1 Synchronization.- The code train generator shall contain a crystal controlled oscillator as a calibrated timing source. The oscillator and related circuitry shall provide internal synchronization (3.4.1.2). A front panel, two position, trigger select switch shall be provided for selecting internal or external triggers for code-train generator synchronization. All features of the code train generator except the internal PRF generator and noise generator (3.4.4) shall operate in synchronization with the external trigger when external synchronization is selected; the internal PRF-period generator shall remain in an operate condition, but its output will not be used until internal synchronization is selected. The noise generator output shall be available when selected regardless of internal/external synchronization position.

3.4.1.1 Internal PRF-period generator.- The internal PRF-period generator shall be enabled and synchronized by the crystal controlled oscillator and related circuitry. The PRF-period generator shall generate a crystal controlled time period adjustable by front panel, indicator type thumb wheel selector switches from 200 to 9,999 microseconds in 1.0 microsecond intervals. The output period accuracy and indication dial accuracy shall be

0.01 percent over the entire range, and the jitter shall be less than 0.040 microseconds for any period selected. Two plastic encapsulated conversion charts, converting time periods to PRF in increments of 25 pulses per second shall be provided with each test set. The PRF-period output shall be used for all internal timing of the test set when internal synchronization is selected.

3.4.1.2 External synchronization.- A front panel input BNC connector shall be provided for accepting external synchronization triggers. The trigger input circuit shall incorporate a 75 ohm terminating resistor that can be switched in or out of the input circuit by means of a front panel switch. With the 75 ohm resistor switched out, the impedance of the input circuit which shall be capacitive coupled shall be a minimum of 20,000 ohms.

3.4.1.2.1 External trigger.- External input trigger characteristics are:

a.	Pulse polarity:	Positive
b.	Pulse duration:	0.3 to 10 microseconds
c.	Pulse amplitude:	2.5 to 50.0 volts across 75 ohms terminating resistor
d.	Pulse PRF:	Any rate from 50 to 2,000 pulses per second inclusive
e.	Pulse rise time:	Less than 0.5 microsecond per volt

3.4.1.3 Trigger generator.- The trigger generator shall be enabled and synchronized by either the internal PRF-period generator (3.4.1.1) or by an external trigger (3.4.1.2) depending on the position of the internal/external synchronization switch (3.4.1). Two separate, electrically isolated, zero delay ("0") triggers shall be available at separate front panel BNC connectors. One electrically isolated delay trigger shall also be available at a separate front panel BNC connector. The delay shall be continuously variable in increments of 1.0 microsecond from 1.0 microsecond to 400 microseconds by means of front panel controls. The sensitivity and accuracy of the delay controls shall be such that any delay within the range specified can be set (using only the delay controls) to within 0.05 microseconds. Jitter of the delay trigger with respect to the "0" trigger shall not exceed 0.01 microseconds. Thumbwheel selector switches shall be used for setting the delay.

3.4.1.3.1 "0" and delay trigger characteristics.- Pulse characteristics of the "0" and delay triggers when driving 75 ohm terminating resistors shall be as follows:

a.	Pulse polarity:	Positive
b.	Pulse amplitude:	15 $\pm$ 2 volts
c.	Pulse width:	1.0 $\pm$ 0.1 microseconds
d.	Pulse rise time:	less than 0.15 microsecond
e.	Pulse decay time:	less than 0.15 microsecond
f.	"0" trigger jitter:	less than 0.01 microsecond (with reference to the synchronization trigger - internal or external)

3.4.2 Interrogation mode trigger generator.- The interrogation mode trigger generator shall be internally enabled by either the "0" trigger or the delay trigger from the trigger generator. Selection of the desired trigger shall be by a front panel, two position, "0"-delay trigger select switch. The interrogation mode generator shall provide modes 1, 2, 3A, B, C, and D interrogation triggers (see 3.2.3), mode interlace (see 3.4.2.2.1), and mode designator triggers (3.4.2.2.2).

3.4.2.1 Interrogation mode triggers.- The interrogation mode triggers (consisting of P1 and P3 pulses) shall be available at a separate front panel BNC connector. A separate front panel switch shall be provided to allow switching the interrogation mode triggers in a non-additive manner to the composite video output BNC connector (3.4.3). Pulse characteristics of the interrogation mode triggers when driving a 75 ohm terminating resistor and when driving the composite video circuitry are as follows:

a.	Polarity	Positive
b.	Amplitude	variable from 2.0 to 15 volts, minimum
c.	Rise time	less than 0.1 microsecond
d.	Decay time	less than 0.2 microsecond

3.4.2.1.1 Interrogation mode trigger duration.- By means of front panel controls it shall be possible to select variable pulse widths for all modes selected. The pulse widths (P1 and P3) shall be variable from 0.2 to 1.5 microseconds. These controls shall be detented at nominal pulse width (0.8 microsecond).

3.4.2.1.2 SLS pulse (P_2).- The P_2 pulse shall be selectable by means of a front panel IN/OUT switch. When selected, the P_2 pulse shall be available at the interrogation mode trigger connector (3.4.2.1) and also the composite video output connector when the interrogation mode triggers are switched to this connector (3.4.2.1). P_2 pulse width shall be variable from 0.2 to 1.5 microseconds and controlled by the P_1 and P_3 pulse width control, see 3.4.2.1.1. P_2 pulse characteristics shall be as specified for interrogation mode triggers (see 3.4.2.1).

3.4.2.2 Mode selection.- The mode control circuitry shall provide individual mode selection capability by means of individual front panel thumbwheel selector switches. The front panel mode select switches shall enable mode designators X and Y (see FAA-E-2319b specification) to be any one of modes 1, 2, 3/A, B, C, and D.

3.4.2.2.1 Mode interlace.- The mode interlace circuitry by front panel selection shall provide for selected interlace of two interrogation modes or operation on a single interrogation mode (no interlace). The following specific interlace patterns shall be attainable for two mode designators (X, Y) by operation of a front panel switch(s):

(a) No interlace-continuous interrogation on X
(b) No interlace-continuous interrogation on Y
(c) X, Y, X, Y, X, Y, etc.
(d) X, X, Y, X, X, Y, X, X, Y, etc.

3.4.2.2.2 Mode designator triggers.- The interrogation mode trigger generator shall provide individual front panel BNC connectors for mode designator triggers (X and Y). Each mode designator trigger shall consist of a single pulse occurring at P3 time of its appropriate interrogation period. That is, the mode designator trigger shall be present only when its designated mode is generated. Mode designator trigger shall have the same pulse characteristics as specified for "0" and delay triggers (see 3.4.1.3.1).

3.4.3 Reply video code train generators.- The video test set shall contain two independent code train generators. The output of each code train generator shall be available at separate electrically isolated front panel BNC connectors. In addition the output of the code train generators shall be non-additively mixed (when selected) and available as composite video signals at two separate electrically isolated front panel BNC connectors. A total of four BNC output connectors shall be provided as follows: One connector for each code train generator and two composite video output connectors. Pulse characteristics of the reply codes shall be as specified in paragraph 3.2.4 reply codes.

3.4.3.1 Triggering of reply code train generators.- By means of a front panel trigger select switch provided on each code train generator, it shall be possible to enable the reply code train generators with any of the following triggers:

(a) External trigger
(b) Mode designator trigger X
(c) Mode designator trigger Y

A front panel BNC connector shall be provided on each reply code train generator for accepting the external trigger whose characteristics shall be as specified in 3.4.1.2.1. It shall also be possible through the external connector to externally trigger the reply code train generator with noise from the noise generator (3.4.4.1). All other trigger inputs shall be internally switched. The trigger select switch on each code train generator shall have an OFF position.

3.4.3.1.1 Reply code train generator interlace.- The reply code train generators when being triggered with mode designator triggers shall interlace in accordance with 3.4.2.2.1.

3.4.3.2 Reply code train delay.- A variable delay shall be provided in each reply code train generator to delay the synchronizing trigger prior to code train generation. The delay shall cover a range from 3.0 to 3,000 microseconds and shall be continuously variable in increments of 1.0 microseconds over the entire range. The delay settings shall be performed by means of front panel indicator type controls only. The accuracy of the delay controls shall be such that any desired delay within the delay range can be set to within 0.50 microseconds. The maximum allowable jitter with respect to the initiating trigger shall be 0.03 microseconds or less over the entire delay range.

3.4.3.2.1 Reply code train delay trigger.- A delay trigger representing the delay selected shall be provided at a BNC connector located on the front panel of each reply code train generator. Pulse characteristics of this delay trigger shall be specified for the "0" and delay triggers in 3.4.1.3.1 except jitter shall be as specified in 3.4.3.2.

3.4.3.3 Reply code train one.-In addition to the features discussed (see 3.4.3-3.4.3.2.1) reply code train one shall have the following functional capabilities (3.4.3.5):

(a) Code selection (A, B, C and D pulses)
(b) Selectable framing pulses
(c) X and SP IDENT pulse selection
(d) Code train pulse width adjust
(e) Emergency code simulations
(f) Code train pulse amplitude adjust

3.4.3.4 Reply code train two.- In addition to the features already discussed (3.4.3-3.4.3.2.1), reply code train two shall have the following functional capabilities (3.4.3.5):

(a) Fine variable delay
(b) Code selection (A, B, C and D pulses)
(c) Fixed framing pulses
(d) X and SP IDENT pulse selection
(e) Code train pulse width adjust
(f) Code train pulse amplitude adjust

3.4.3.5 Reply code train functional capabilities.- All controls relating to the functional capabilities shall be located on the front panel of each reply code train generator.

3.4.3.5.1 Code selection.- Thumb wheel switches shall be provided to select any desired code combination of A, B, C and D pulses as defined in paragraphs 3.2.4-3.2.4.1.2.

3.4.3.5.2 Fine variable delay.- Front panel fine delay controls capable of varying the delay in increments of 0.1 microseconds over a range of ±3.0 microseconds from the selected code train position shall be provided. Accuracy of the delay controls shall be 0.01 microseconds or less. Thumbwheel selector switches shall be used for delay settings.

3.4.3.5.3 Selectable framing pulses.- Framing pulses (see 3.2.1.8) shall be selectable by means of separate individual IN/OUT switches for F1 and F2. When the switches are in the IN position, the framing pulses shall be displayed along with the code pulses at the composite video outputs and at the isolated video output connector for code train one.

3.4.3.5.3.1 Fixed framing pulses.- When the selectable framing pulse feature is not required, fixed framing pulses shall be provided and displayed along with the code pulses at the composite video outputs and at the isolated video output connector for code train two .

3.4.3.5.4 X and SP IDENT pulse selection.- Both X and the SP IDENT pulses shall be selectable by means of separate individual IN/OUT switches. The selected pulse(s) shall be displayed with the code train at the composite video outputs and at the isolated video output connectors for each code train generator.

3.4.3.5.5 Code train pulse width adjust.- A pulse width adjust control shall be provided for adjusting pulse widths over a range of 0.15 to 1.00 microseconds. The control shall have detent positions for 0.35, 0.45 and 0.55 microseconds. The detent positions shall be accurate within 0.01 microseconds. This adjustment also applies to the framing pulses.

3.4.3.5.6 Code train pulse amplitude adjust.- A pulse amplitude adjust control shall be provided to vary pulse amplitudes of code trains between 0.5 and 15.0 volts prior to being mixed with the composite video output signals and at the output of the BNC connectors provided for the output of each code train generator.

3.4.3.5.7 Military Emergency code simulation.- A separate three position switch shall be provided to simulate various emergencies. Position one of the switch shall be an OFF position. When in switch position two, the selected code shall be repeated four times for each PRF. When in switch position three, the selected code shall be repeated one time followed by three sets of framing pulses (no code pulses) for each PRF. In both switch positions two and three, the spacing between code trains shall be 4.35 ± 0.1 microseconds.

3.4.4 Noise generator.- A random noise generator selectable by a front panel ON/OFF switch shall be provided in the video test set. The generator shall generate 13 MHz random noise. A linear amplifier and associated front panel control shall be provided to vary the noise duty cycle up to 60 percent. The control indicator shall be accurate within 10 percent. The output noise amplitude shall be variable by a front panel control from 0.25 to 5.0 volts when driving a 75 ohm terminating resistor.

3.4.4.1 Noise generator outputs.- The noise generator shall supply two separate isolated outputs. One output shall be provided through a separate front panel BNC connector; it shall be capable of externally triggering the reply code trains generator. The other noise output when selected by a front panel IN/OUT switch shall be applied through an isolation circuit and non-additive mixed with the signals at the composite video outputs (3.4.5). The noise shall be gated around the mode interrogation triggers appearing on the composite video output.

3.4.5 Composite Video Outputs.- The composite video output shall be composed of any of these selectable functions; noise generator (3.4.4), interrogation mode triggers (3.4.2.1), and reply video (3.4.3). The composite video outputs shall be available at two electrically isolated front panel BNC connectors. By means of front panel controls, the composite video outputs shall be continuously variable between 0.5 and 15 volts when terminated in a 75 ohm resistor.

4. QUALITY ASSURANCE PROVISIONS

4.1 General requirements for inspection and test.- See Section 1-4 of FAA-G-2100/1.

4.2 Required tests.- The contractor shall submit for approval, along with the proposed test methods and forms under 1-4.2 of FAA-G-2100/1, three copies of a comprehensive test plan including a list of tests to be performed under each class of tests specified in 1-4.3 of FAA-G-2100/1. The Government reserves the right to require any additional tests necessary to assure that all of the specification requirements are checked. The tests shall include, but not be limited to the following:

a. Design qualification tests.- The following tests shall be performed under normal and environmental conditions as specified in paragraph 4.2.3:

Synchronization	3.4.1 ; 3.4.1.1; 3.4.1.2
External trigger	3.4.1.2.1
"0" and delay trigger characteristics	3.4.1.3.1
Interrogation mode trigger generator	3.4.2 thru 3.4.2.1.2

Mode selection	3.4.2.2
Mode interlace	3.4.2.2.1
Mode designator triggers	3.4.2.2.2
Reply video code train generators	3.4.3
Triggering of reply code train generators	3.4.3.1
Reply code train generator interlace	3.4.3.1.1
Reply code train delay	3.4.3.2
Reply code train delay trigger	3.4.3.2.1
Reply code train one	3.4.3.3
Reply code train two	3.4.3.4
Reply code train functional capabilities	3.4.3.5
Code selection (all code train generators)	3.4.3.5.1
Fine variable delay (code train generator 2)	3.4.3.5.2
Selectable framing pulses	3.4.3.5.3
Fixed framing pulses (code train 2)	3.4.3.5.3.1
X and SP IDENT pulse selection (both code train generators)	3.4.3.5.4
Code train pulse width adjust (both code train generators)	3.4.3.5.5
Code train pulse amplitude adjust (both code train generators)	3.4.3.5.6
Military Emergency code simulation	3.4.3.5.7
Noise generator	3.4.4; 3.4.4.1

Power supply	3.3.15 thru 3.3.15.2
Radiation interference and susceptibility	3.3.17
Composite video output	3.4.5

b. Type Tests.- The following tests including environmental testing shall be made while subjecting the equipment to type test procedures described in 1-4.3.3, 1-4.3.3.1 and 1-4.12 of FAA-G-2100/1b.

Internal PRF - period generator	3.4.1.1
Trigger generator	3.4.1.3; 3.4.1.3.1
Interrogation mode triggers	3.4.2 thru 3.4.2.1.2
Mode selection and interlace	3.4.2.2; 3.4.2.2.1
Mode designator triggers	3.4.2.2.2
Reply video code train generators	3.4.3
Reply code train delay	3.4.3.2 ; 3.4.3.2.1
Code selection (both code train generators)	3.4.3.5.1
Fine variable delay (code train generator 2)	3.4.3.5.2
Selectable framing pulses	3.4.3.5.3; 3.4.3.5.3.1
X and SP IDENT pulse selection (both code train generators)	3.4.3.5.4
Code train pulse width adjust (both code train generators)	3.4.3.5.5
Code train pulse amplitude adjust (both code train generators)	3.4.3.5.6
Military Emergency code simulation	3.4.3.5.7
Noise generator	3.4.4; 3.4.4.1

Power Supply	3.3.15 thru 3.3.15.2
Composite video output	3.4.5

c. Production Tests.- The following test shall be in accordance with 1-4.3.4 of FAA-G-2100/1b:

Internal PRF - period generator	3.4.1.1
Trigger generator	3.4.1.3; 3.4.1.3.1
Interrogation mode trigger generator	3.4.2 thru 3.4.2.1.2
Mode selection and interlace	3.4.2.2; 3.4.2.2.1
Mode designator triggers	3.4.2.2.2
Reply video code train generators	3.4.3
Reply code train delay	3.4.3.2; 3.4.3.2.1
Code selection (both code train generators)	3.4.3.5.1
Fine variable delay (code train generator 2)	3.4.3.5.2
Selectable framing pulses	3.4.3.5.3
Fixed framing pulses (code train generator 2)	3.4.3.5.3.1
X and SP IDENT pulse selection (both code train generators)	3.4.3.5.4
Code train pulse width adjust	3.4.3.5.5
Code train pulse amplitude adjust	3.4.3.5.6
Military Emergency code simulation	3.4.3.5.7
Noise generator	3.4.4; 3.4.4.1
Power supply	3.3.15 thru 3.3.15.2
Composite video output	3.4.5

4.2.1 Reliability demonstration.- As a part of the Design Qualification Tests, the contractor shall perform a reliability demonstration of the test set in accordance with paragraph 4.2 of MIL-STD-781B and the requirements of this specification. The reliability demonstration shall be performed in accordance with Test Level A-1, Test Plan V of MIL-STD-781B.

4.2.1.1 Reliability demonstration test plan.- Thc contractor shall submit for approval to the Government's contracting officer a reliability demonstration test plan which conforms to the requirements of paragraph 4.2.1 herein. The reliability test plan shall be submitted sixty (60) days prior to start of test and shall be approved prior to conducting the test.

4.2.2 Maintainability demonstration.- As a part of the design Qualification Test the contractor shall perform a maintainability demonstration in accordance with Method 3 of MIL-STD-471 and the requirements of this specification.

4.2.3 Enviromental testing.- The Design Qualification Tests shall include an environmental test in accordance with 1-4.12, 1-3.3.1 and 1-3.3.1.1 of FAA-G-2100/1b. The environmental test shall demonstrate compliance to the performance requirements specified herein when operating over the range of service conditions specified in 3.3.3.

4.2.4 Twenty-four hour burn-in test.- All production equipments shall undergo a twenty-four hour burn-in test at the completion of production testing. After a 10 minute warm up period the equipment shall be adjusted and aligned for optimum performance and test measurements taken and recorded to verify all features are functioning properly. The equipment shall then operate for 24 hours during which time only front panel controls may be manipulated. At the end of the 24 hour operating period, the test measurements shall be repeated and recorded. All observations of malfunctioning or instability in the equipment shall be recorded on test data sheets and will serve as a log or history of the test. The Government representative/s shall be permitted to make any number of entries in the combined Government-contractor log even if not concurred with by representatives of the contractor. The equipment shall not be de-energized more than one time during the 24 hour time period and the total outage shall not exceed thirty minutes; if either of these are exceeded, the 24 hour burn-in test shall be repeated. All specification requirements specified herein shall be met during this test.

4.3 Quality control program.- The contractor shall prepare and maintain a quality control program which fulfills the requirements of FAA-STD-013a. Three copies of the quality control program shall be submitted to the Government for approval. The contractor's quality control program shall be a scheduled and disciplined plan of events intergrating all necessary inspections and tests required to substantiate product quality during design, development, purchasing, subcontracting, shipping; and, where required by the contract, site installation. The contractor shall perform

or have performed the inspections and test required to substantiate product configuration and conformance to drawings, specifications and contract requirements and shall also perform or have performed all inspections and tests otherwise required by the contract. The contractor shall provide and maintain gages and other measuring and testing devices necessary to assure that materials, equipments, and systems conform to the technical requirements. In order to assure continued accuracy, these devices shall be calibrated at established intervals against certified standards which have knownvalid relationships to national standards. If production tooling, such as jigs, fixtures, templates, and patterns is used as a media of inspection, such devices shall also be provided for accuracy at established intervals. When required, the contractor's measuring and testing equipment shall be made available for use by the FAA Inspector to determine conformance of product with contract requirements. In addition, if conditions warrant, contractor's personnel shall be made available for operations of such devices and for verification of their accuracy and condition.

5. PREPARATION FOR DELIVERY

5.1 General packing requirements.- See FAA-G-2100/1b, paragraph 1-5.1.

5.2 Shipping instructions.- The Government will supply shipping information upon request from the contractor at the time the equipment is ready for shipment.

6. NOTES

6.1 Notes.- None.

Attachment: Drawing A-31054A

APPENDIX I

TABLE OF CONTENTS

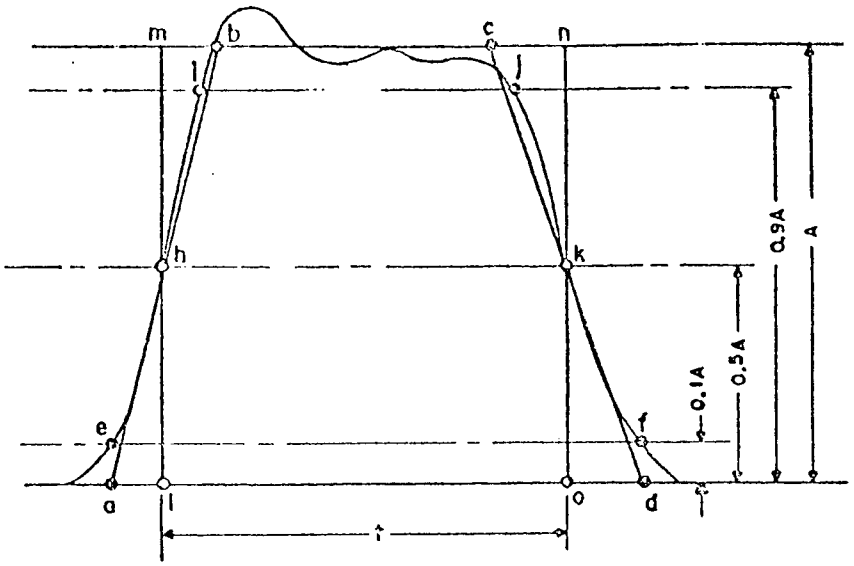

FIGURE 1

CONSTRUCTION OF EQUIVALENT RECTANGULAR AND TRAPEZOIDAL PULSE SHAPES

1. BY SUCCESSIVE APPROXIMATION OBTAIN RECTANGULAR PULSE (AMPLITUDE A) OF AREA EQUAL TO AREA UNDER ACTUAL PULSE AND PASSING THROUGH THE 0.5A POINTS (h, k.) ON THE ACTUAL PULSE ENVELOPE. THIS IS RECTANGLE I mno.

2. CHOOSE POINTS c f AND I J ON THE ACTUAL PULSE AT 0.1A AND 0.9A LEVELS RESPECTIVELY.

3. THROUGH h DRAW a h b PARALLEL TO A STRAIGHT LINE CONNECTING e AND I.
THROUGH k DRAW d k c PARALLEL TO A STRAIGHT LINE CONNECTING f AND J.
THEN EQUIVALENT TRAPEZOIDAL PULSE a b c d.

NOTE: AREA a b c d = AREA OF RECTANGLE.
= AREA OF PULSE.